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PATENT SPECIFICATION

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(19)

(54) IMPROVEMENTS RELATING TO ANAESTHESIA MACHINES

(71) We, CYPRANE LIMITED, of New Devonshire House, Scott Street, Keighley, in the County of York, a British Company, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to anaesthetic machines. Machines at present in use incorporate a back-bar to which the various anaesthesia units, such as flowmeters and vapourisers, are secured. Fluid connections between the various units are made by mating sockets and spigots aligned to give a flow path which is generally parallel to the back-bar. The seals obtained between the sockets and spigots are often not very satisfactory. Installation and removal of these units is a time-consuming and cumbersome operation. Apart from routine maintenance difficulties this can cause dangers if any unit should fail while the machine is in use during an operation. The failed unit cannot be replaced rapidly and it is necessary to replace the entire machine with a standby machine which may be more or less ready for use. Further difficulty arises in operation wherein cauterisation is necessary after the use of an explosive anaesthetic, such as ether.

According to the present invention there is provided anaesthesia equipment including a rack, an anaesthesia unit (as hereinafter defined) removably plugged into position on said rack, fluid connecting elements on the rack, mating elements on said anaesthesia unit, each of said mating elements engaging with a respective one of said fluid connecting elements in plug-in fashion to effect a fluid-conveying connection, an inlet for fluid, an outlet for fluid, and fluid-circuit pipework secured to the rack and forming part of means interconnecting both the said fluid inlet with one of the said fluid-connecting elements, and the said fluid outlet with another of the said fluid-connecting elements.

Also separately provided by the present invention are:—

(i) the rack forming part of the anaesthesia equipment of the invention, the rack having mounted thereon the fluid-connecting elements and the fluid-circuit pipework; and

(ii) the anaesthesia unit (as hereinafter defined) forming part of the anaesthesia equipment of the invention, the unit being provided with the mating elements.

The rack may also be provided with further fluid-connecting elements for engagement in plug-in fashion with mating elements on other anaesthesia units.

When used herein the term "anaesthesia unit" means a flowmeter, mixer, volumeter, vapouriser or ventilator. Other items, hereinafter referred to as "ancillary units," which may be mounted on a rack according to the invention include a pressure gauge, a blood pressure monitor, a pulse monitor, a reservoir bag, a suction unit, an emergency oxygen supply, an oxygen lack warning device, an oxygen concentration meter, an anaesthetic concentration meter, a pressure relief valve, a patient breathing and inflating valve, and an excess vapour filtration or extraction assembly. Thus equipment may be built up into the form required merely by plugging units (anaesthesia and, if desired, ancillary) into position on the rack.

A plug-in arrangement of this nature simplifies the installation and removal of an anaesthesia unit from the machine, so facilitating maintenance. Replacement of a single unit if this should fail during an operation can easily be made, and there is no need to use a standby machine. When cauterising after using an explosive anaesthetic the anaesthetic unit that contained the anaesthetic can be removed from the machine and taken outside the operating theatre before cauterisation commences, so removing any danger of explosion.

The anaesthesia unit of the invention preferably has a rear wall which abuts against a front vertical surface of the rack and the axes of at least some of the fluid connecting elements are perpendicular to the front surface of the rack or are parallel to the front surface of the rack. In a particularly advantageous arrangement the rack has a front face and a top face perpendicular to the front face, the top face being provided with fluid connecting elements having axes perpendicular to the top face, and the front face being provided with fluid connecting elements having axes perpendicular to the front face.

Each fluid connecting element may be provided with sealing means to prevent leakage of fluid from the fluid connecting element on withdrawal of the anaesthesia unit from the rack. The sealing means preferably comprises a valve operable by a mating element on the anaesthesia unit to effect said fluid-conveying connection.

The fluid connecting elements may include a first and a second fluid connecting element engaging with a first and a second mating element respectively on the anaesthesia unit and a by-pass connection interconnecting said first and second fluid connecting elements, and the valves of said first and second fluid connecting elements being such that, on withdrawal of the anaesthesia unit, fluid flow is possible between the first and second fluid connecting elements along said bypass connection.

Continuity of the fluid circuit may alternatively be achieved by the use of a connection block to connect the first and second fluid connection elements.

The anaesthesia equipment may include a gas mixer unit and a selector unit, both being secured to the rack, the rack having two or more sets of inlet and outlet fluid connecting elements, each set comprising one inlet and one outlet fluid connecting element for receiving a respective anaesthetic vapouriser, and fluid conduits secured to the rack connect the gas mixer unit, the selector valve and the inlet fluid connecting elements of the sets in such a way that the selector valve can be operated to direct gas from the mixer unit to the inlet fluid connecting element of any selected set. Preferably, the selector valve is connected by further fluid conduits, secured to the rack, to the outlet fluid connecting elements of the sets and is operative to direct gas from the outlet fluid connecting element of any selected set to the outlet for fluid.

The rack may comprise a plurality of defined bays each for receiving an anaesthesia unit or an ancillary unit, and as it may be undesirable to have certain units positioned in certain bays of the rack, some or all bays may therefore be provided with indexing means co-operating with indexing means on the units to ensure that only a particular type of unit may be mounted in a particular bay. The indexing means may simply be different bay sizes, or connecting elements provided in the bays may be indexed so that they will receive only a particular style of connector with which a unit is provided. Preferably, however, the indexing means are separate from the connecting elements.

Some or all of the bays may be designed on the modular principle to receive units constructed to a standard measure of length or width or both. Some or all of the bays of the rack are each conveniently provided with at least two fluid connecting elements. Some or all of the bays may also be provided with electrical plugs or sockets for making electrical connection to units in those bays.

In order that the invention may be better understood specific embodiments thereof will now be described, by way of example only, with reference to the accompanying drawings in which:—

Figure 1 is a schematic front elevation of a first form of rack with anaesthesia units thereon;

Figure 2 is a view, partly in section, taken on the line A—A of Figure 1;

Figure 3 is a schematic rear elevation of the rack of Figure 1, with a cover plate removed;

Figure 4 is a schematic front elevation of a second form of rack with units fitted thereto;

Figure 5 is a view taken on the line B—B of Figure 4;

Figure 6 is a schematic perspective view of a third form of rack; and

Figure 7 is a section through a valved socket assembly.

Figures 1 to 3 show a simple form of the invention wherein anaesthesia equipment is provided with a rack in the form of a bar 1 of U-shaped cross section and having a front face 2, a top face 3 and a bottom face 4. The open rear face of the bar is closed by a removable cover plate 5. The ends of the top and bottom faces are formed with holes for receiving bolts by way of which the bar may be mounted on an anaesthesia machine, floor stand, wall bracket, ceiling bracket, arm from an operating table or other form of support.

The bar is designed to receive and support two plug-on anaesthetic vapourisers 6 and 7, each designed for use with a different anaesthetic. To this end the top face 3 of the bar is formed with a first pair of inlet and outlet spigots 8 and 9 for the vapouriser 6, and with a second pair of inlet and outlet spigots 10 and 11 for the vapouriser 7. Each spigot has a stem 12 (Figure 2) threaded into

a tapped bore in the top web of the bar and having means at its lower end to which a fluid pipe connector 13 can be secured. Each spigot carries an O-ring seal 14. Each of the vapourisers 6 and 7 comprises a body 15 having a rearwardly projecting upper flange 16 formed with two sockets such as 17 which fit over the respective inlet and outlet spigots, the O-ring seal 14 ensuring that the resulting connection is fluid-tight. The sockets connect by way of bores such as 18 with the interior of the vapouriser, which may be of conventional internal construction.

Bolted to the front face 2 of the bar in conventional manner is a mixer unit 19 designed to receive gases (for example oxygen and nitrous oxide) from gas supply lines connected to the mixer unit. The mixer unit may be of any design which will allow control of total output gas flow and of the proportions of different gases in the output flow. Mounted within the bar is a selector valve 20 having a control knob 21 exposed on the front face 2. The selector valve has two banks of valve connections operated in tandem by the control knob and may be of any suitable construction.

The output from the mixer unit 19 is connected to the input of a first bank of valve connections by a conduit 22, and two separate outlet connections of that bank are connected by conduits 23, 24 to the input spigots 8, 10 respectively for vapourisers 6 and 7. The output spigots 9, 11 respectively are connected by conduits 25, 26 to two separate inlet connections of a second bank of the valve, and the outlet connection from that bank is connected by a conduit 27 to a supply spigot 28, which may be of the tapered form specified by International Standards or may be similar to spigots 8 to 11, on the front face 2 of the bar, this supply spigot forming the outlet for the supply of mixed carrier gas and anaesthetic vapour to the patient.

With the valve in the position shown in Figures 1 and 3 gas from the mixer unit 19 flows through conduit 22, the first bank of the valve and conduit 23 into vapouriser 6. Gas loaded with anaesthetic vapour then flows from vapouriser 6 through conduit 25, the second bank of the valve, conduit 27 and the outlet spigot for supply to the patient.

By changing the position of the valve 20 by rotation of knob 21 the vapouriser 7 may be connected into the circuit rather than the vapouriser 6. It will be seen that the vapouriser that is not connected into the circuit is totally isolated from the gas flow. Cross-contamination of the anaesthetics from the two vapourisers, which may be potentially dangerous, is thus avoided. This parallel connection of vapourisers is not necessary, and the conventional arrangement of series connected vapourisers may be used, and the selector valve then omitted.

The assembly shown in Figures 1 to 3 also includes a conduit 29 connecting a supply of pure oxygen from a connection 30 in mixer unit 19 to a valve 31 which may be operated to pass oxygen to the supply spigot 28. This provides an emergency oxygen supply which can be administered to the patient as required by a suitable control 31*a* for valve 31.

From the foregoing description it will be appreciated that the vapourisers may be removed from and fitted to the rack in a very simple manner, merely by lifting the vapouriser sockets off the spigots or lowering them on to the spigots. When in position on the spigots the vapouriser is held securely on the bar 1. If required, a vapouriser may be removed from the bar and the exposed spigots may then be connected by a connecting block having sockets for fitting over the spigots, the sockets being connected by an internal bore in the block.

Figures 4 and 5 show a rack comprising a plate 40 to which are secured two forwardly projecting elements 41, 42 and two rearwardly projecting webs 43, 44. A back plate 45 is fixed to the webs 43, 44. Secured to the rack in conventional manner are a set of pressure gauges 46, a mixer unit 47, a selector valve 48, and a plate 49 having an emergency oxygen outlet valve control 50 and a gas/anaesthetic vapour outlet spigot 51. The upper web 43 has two sets of spigots 52, 53 and 54, 55 into which sockets on two vapourisers 56, 57 plug as already described with reference to Figures 1 to 3, the vapourisers being further supported by element 41. Below the element 41 the plate 40 has two sets of spigots 58, 59 and 60, 61 projecting with their axes perpendicular to the plate 40. Plugged into one set of the spigots are sockets on a volumeter 62, and plugged onto the other set are sockets on a ventilator 63, the volumeter and ventilator being further supported by element 42. The four sets of spigots, the pressure gauges, the mixer unit, the selector valve, the emergency oxygen spigot and the gas/anaesthetic vapour outlet spigot are appropriately interconnected by conduits (not shown) secured to the rack and located behind the plate 40.

The rack shown in Figure 4 provides four defined bays, two side by side upper bays for receiving vapourisers, and two side by side lower bays for receiving other anaesthesia units. The bays are designed on the modular principle to accept anaesthesia units constructed to a standard measure of width. The vertical spigots for the upper bays and horizontal spigots for the lower bays do in

themselves form an indexing arrangement to prevent vapourisers from being plugged into the lower bays, or ther units with horizontal sockets being plugged into the upper bays. If required, other indexing means may be located in some or all the bays, for example keys secured to the rack and engaging keyways on the housings of the units, to further limit the units that can be received by a particular bay.

It will be understood that racks are not limited to the number or arrangement of bays shown, and as many bays as required may be provided. Although in each example two vapourisers have been shown mounted on the rack this is not necessary and only a single vapouriser may be used. If necessary, some bays may be designed for receiving units of electrical equipment, these bays being equipped with an electrical plug or socket to cooperate with the unit.

Figure 6 shows a typical free-standing form of assembly having a rack 66 upstanding from a table top 69 which may have means for securing gas cylinders such as 69*a* and have conduits for connecting the gas cylinders to the rack. An anaesthesia unit, such as a flowmeter 61 has upper and lower bars 62 and 63 and a vertical back-bar 64. The bars fit into a vertical locating slot in the bay 65 of the rack 66, and the unit is supported by engagement of the bar 62 beneath an upper bar of the rack, and engagement of the bar 63 above a lower bar of the rack. Plugs 67 and 68 on the unit fit into sockets on the rack to allow flow of fluid through the unit. As with the previously described embodiments, fluid-circuit pipework secured to the rack forms part of means interconnecting the sockets on the rack with the fluid inlets and outlets of the equipment.

Other forms and arrangements of anaesthesia equipment within the scope of the present invention as defined by the appended claims will be readily apparent to those skilled in the art.

In those bays where an inlet and an outlet plug or socket element are provided for fluid flow, it is advantageous if the elements are valved to provide a by-pass connection if no anaesthesia unit is present in the bay. Figure 7 shows an example of such a valving arrangement associated with two sockets 70, 71 on the rack for receiving plugs 72, 73 on an anaesthesia unit. The sockets 70, 71 have respectively fluid inlet and outlet passages 74, 75 opening into the sockets, and the two sockets are interconnected by a connecting passage 76. Each socket has a piston member 77, 78 with an O-ring seal slidable therein and biased by a spring 79, 80 to the position shown for piston member 78, showing the socket 71 with the plug 73 removed. In this position the piston 78 lies above connecting passage 76 and seals the socket against escape of gas. With the piston 77 in a similar position it will be seen that the passages 74 and 75 are interconnected by the sockets and passage 76.

On inserting a plug 72 into the socket 70, as shown at the left hand side of the Figure, the piston member 77 is moved against the spring to the bottom of the socket and an internal passage 81 communicates with passage 74, the passage 76 being sealed off by a sealing ring 82 from the plug. A similar connection will be made by plug 73.

Other valving arrangements for achieving the same effect will be readily apparent to those skilled in the art, as will valving arrangements for sealing a single plug or socket element against gas escape if no mating member is in position.

It will be seen that anaesthesia equipment in accordance with the invention provides a versatile system wherein installation and removal of anaesthesia units and ancillary units from their support means and supply lines is facilitated.

WHAT WE CLAIM IS:—

1. Anaesthesia equipment including a rack, an anaesthesia unit (as hereinbefore defined) removably plugged into position on said rack, fluid-connecting elements on the rack, mating elements on said anaesthesia unit, each of said mating elements engaging with a respective one of said fluid connecting elements in plug-in fashion to effect a fluid-conveying connection, an inlet for fluid, an outlet for fluid, and fluid-circuit pipework secured to the rack and forming part of means interconnecting both the said fluid inlet with one of the said fluid-connecting elements, and the said fluid outlet with another of the said fluid-connecting elements.

2. Anaesthesia equipment according to claim 1 in which the anaesthesia unit has a rear wall which abuts against a front vertical surface of the rack and the axes of at least some of the fluid connecting elements are perpendicular to the front surface of the rack.

3. Anaesthesia equipment according to claim 1 in which the anaesthesia unit has a rear wall which abuts against a front vertical surface of the rack and the axes of at least some of the fluid connecting elements are parallel to the front surface of the rack.

4. Anaesthesia equipment according to any of the preceding claims in which the rack has a front face and a top face perpendicular to the front face, the top face being provided with fluid connecting elements having axes perpendicular to the top face and the front face being provided with fluid connecting elements having axes perpendicular to the front face.

5. Anaesthesia equipment according to any of the preceding claims wherein each fluid connecting element is provided with sealing means to prevent leakage of fluid from the fluid connecting element on withdrawal of the anaesthesia unit from the rack.

6. Anaesthesia equipment according to claim 5 wherein the sealing means of each connecting element comprises a valve operable by a mating element on the anaesthesia unit to effect said fluid-conveying connection.

7. Anaesthesia equipment according to claim 6 wherein said fluid connecting elements include a first and a second fluid connecting element engaging with a first and a second mating element respectively on the anaesthesia unit and a by-pass connection interconnecting said first and second fluid connecting elements, and the valves of said first and second fluid connecting elements being such that, on withdrawal of the anaesthesia unit, fluid flow is possible between the first and second fluid connecting elements along said by-pass connection.

8. Anaesthesia equipment according to claim 1 wherein a gas mixer unit and a selector valve are secured to the rack, the rack has two or more sets of inlet and outlet fluid connecting elements, each set comprising one inlet and one outlet fluid connecting element for receiving a respective anaesthetic vapouriser, and fluid conduits secured to the rack connect the gas mixer unit, the selector valve and the inlet fluid connecting elements of the sets in such a way that the selector valve can be operated to direct gas from the mixer unit to the inlet fluid connecting element of any selected set.

9. Anaesthesia equipment according to claim 8 in which the selector valve is connected by further fluid conduits, secured to the rack, to the outlet fluid connecting elements of the sets and is operative to direct gas from the outlet fluid connecting element of any selected set to the outlet for fluid.

10. Anaesthesia equipment according to any one of the preceding claims wherein the rack includes a plurality of defined bays each for receiving an anaesthesia unit or an ancillary unit (as hereinbefore defined).

11. Anaesthesia equipment according to claim 10 in which some or all of the bays are provided with indexing means for co-operating with indexing means on anaesthesia units or ancillary units to ensure that only a particular type of unit may be mounted in a particular bay.

12. Anaesthesia equipment according to claim 10 or claim 11 in which some or all of the bays each have at least two fluid connecting elements.

13. Anaesthesia equipment according to any one of claims 10 to 12 in which some or all of the bays have electrical plugs or sockets.

14. Anaesthesia equipment according to any one of claims 10 to 13 in which some or all of the bays are designed on the modular principle to receive anaesthesia units or ancillary units constructed to a standard measure of length of width or both.

15. Anaesthesia equipment substantially as herein described with reference to Figures 1 to 3, or to Figures 4 and 5 or to Figure 6 of the accompanying drawings.

16. The rack of the anaesthesia equipment claimed in any of the preceding claims, there being mounted on the rack the fluid-connecting elements and the fluid-circuit pipework.

17. The anaesthesia unit (as hereinbefore defined) of the anaesthesia equipment claimed in any of the preceding claims, the mating elements being mounted on said unit.

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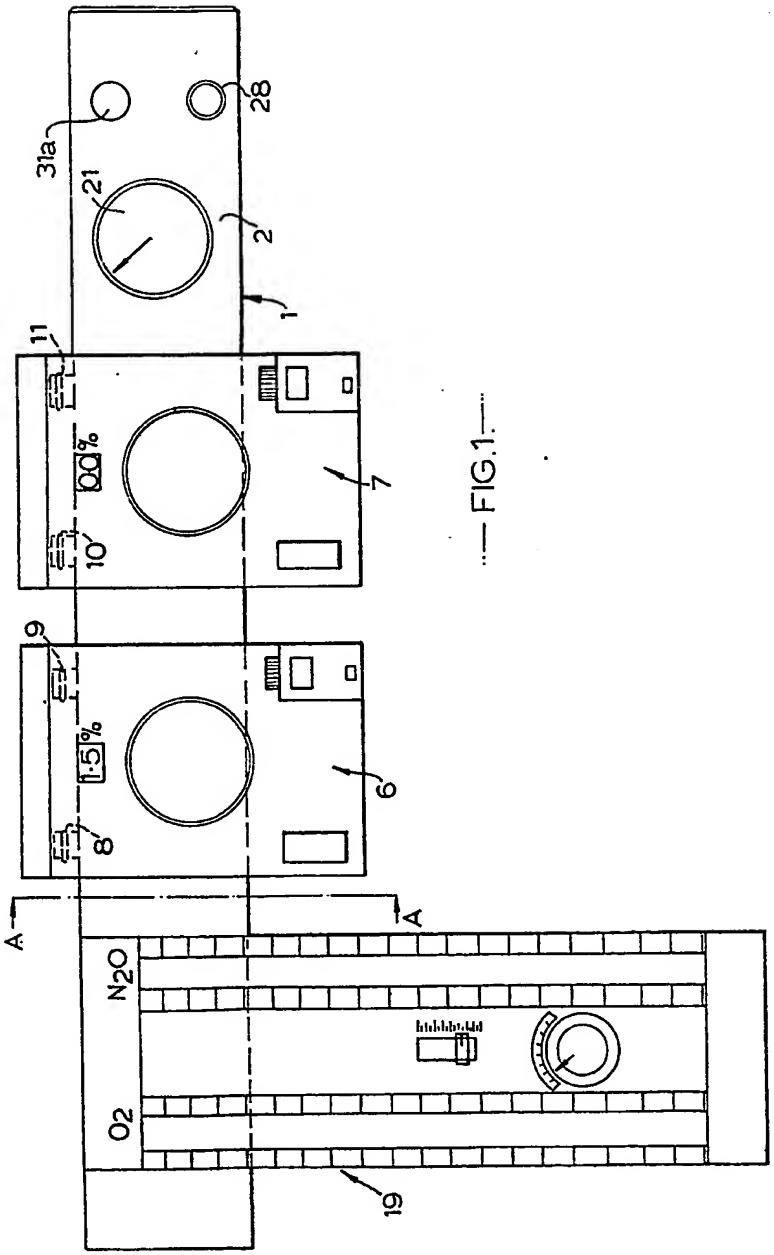
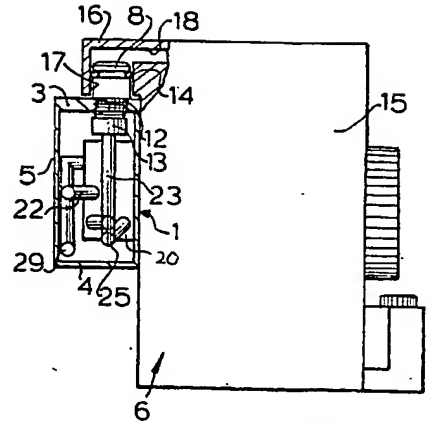


FIG.1.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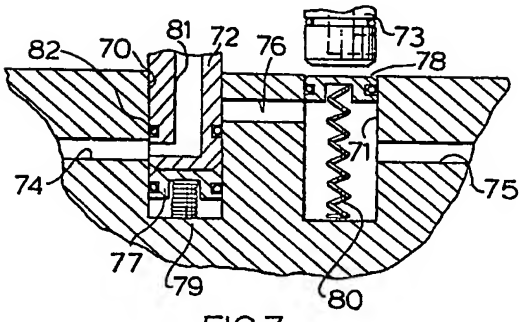
—FIG.2.—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—FIG.7.—

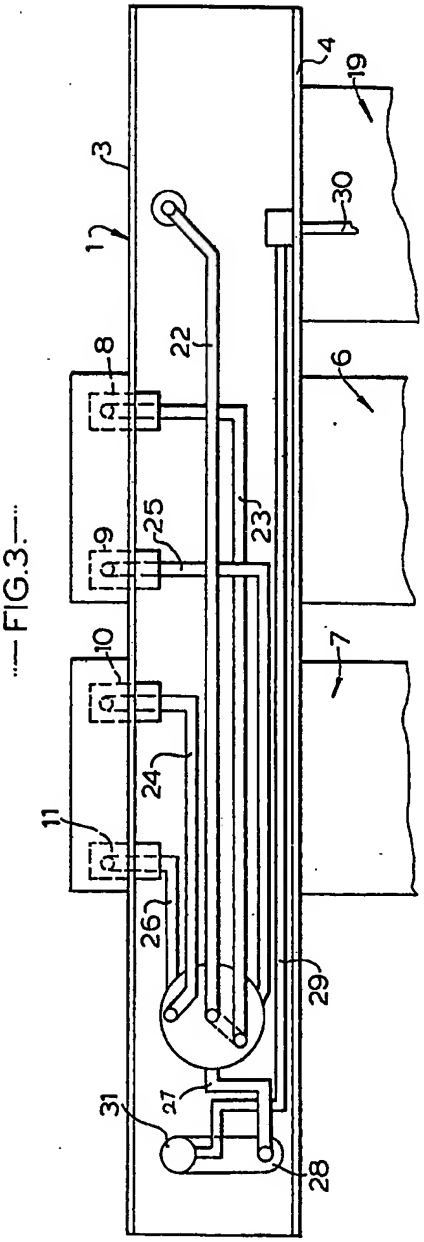

FIG.3.

FIG.4

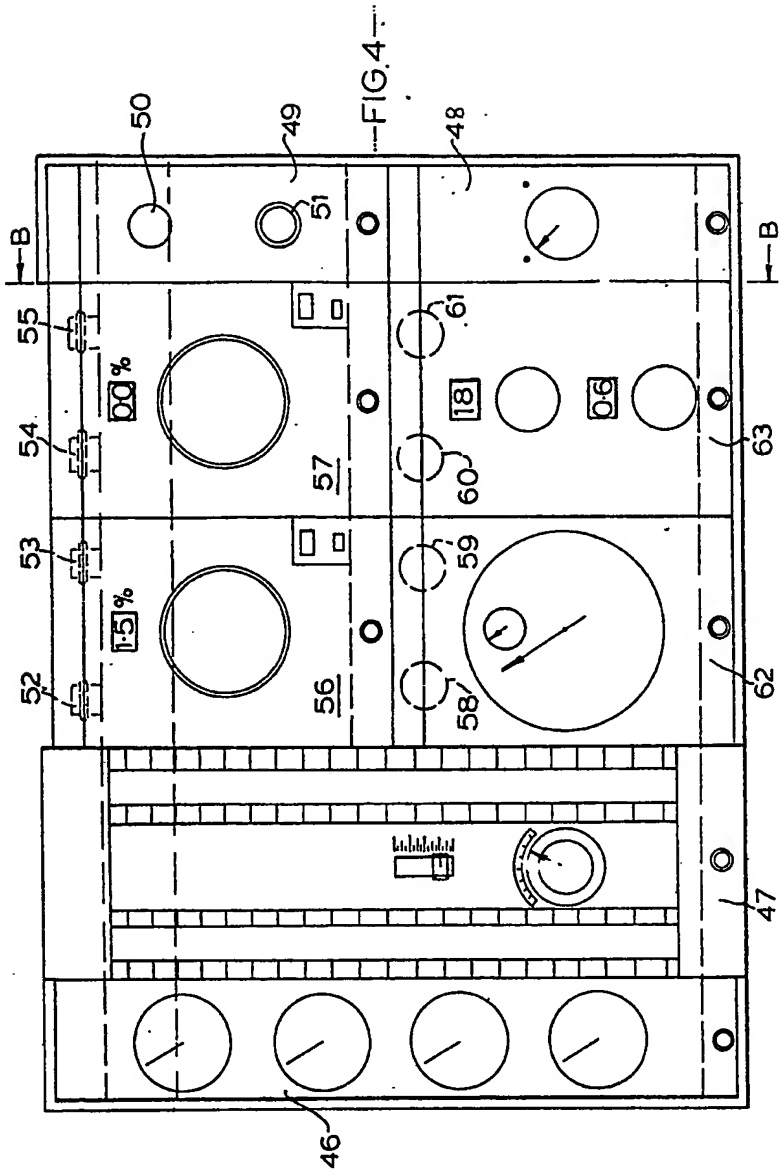

FIG.5.

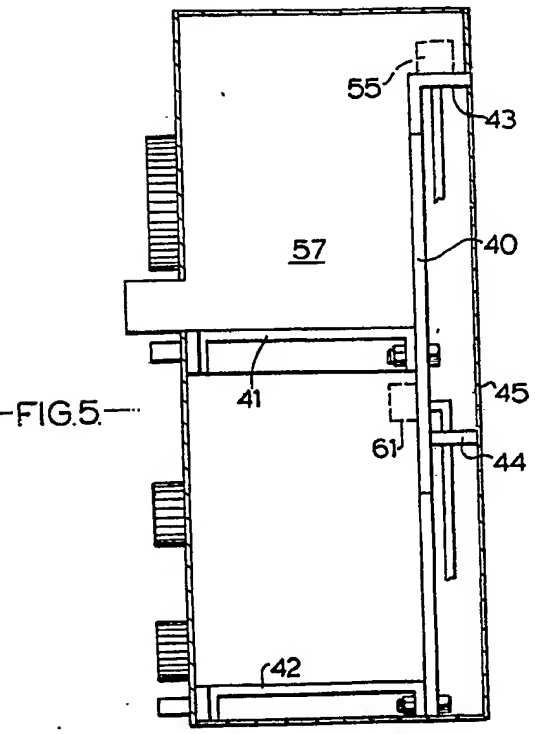

FIG.6.